Comparative Analysis Of The Production Cost Efficiency Of Red Onions (Allium Ascalonicium L.) Using Seed And Bulb Propagation In Lobutua Village, Lintong Nihuta Subdistrict, Humbang Hasundutan Regency

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Abstract

This study aims to analyze a comparison of the production cost efficiency of shallot farming using seed propagation (True Shallot Seed/TSS) and bulb propagation in Lobutua Village, Lintong Nihuta Subdistrict, Humbang Hasundutan Regency. The study area was selected using a purposive sampling method. The research employed a survey method using a Stratified Random Sampling technique involving 23 respondents, consisting of 10 farmers using true shallot seed (TSS) and 13 farmers using bulb propagation. The data were analyzed through production cost analysis, production cost efficiency, revenue, income analysis, and multiple linear regression analysis.The results showed that the average total production cost of shallot farming using the seed propagation method was lower than that of the bulb propagation method, amounting to IDR 92,238,929 per hectare and IDR 92,796,073 per hectare, respectively. The seed propagation method achieved a production cost efficiency of 0.0094%, while the bulb propagation method recorded 0.0082%, indicating a relatively small difference of 0.0012 percentage points.Furthermore, the average revenue from shallot farming using the True Shallot Seed (TSS) propagation method reached IDR 215,865,000 per hectare, which was considerably higher than its total production cost of IDR 92,238,929 per hectare.In comparison, the average revenue from shallot farming using the bulb propagation method reached IDR 190,381,731 per hectare, which also exceeded its average total production cost of IDR 92,796,073 per hectare, indicating that the farming system remained economically profitable despite generating lower revenue than the TSS propagation method.

INTRODUCTION

North Sumatra Province is recognized as one of Indonesia's major shallot-producing regions. This distinction is largely attributed to the province's favorable agroclimatic conditions, particularly in several key production districts where environmental factors such as optimal temperatures, adequate rainfall, fertile soils, and sufficient solar radiation create highly suitable conditions for shallot cultivation. These natural advantages enable farmers to achieve relatively high productivity and maintain continuous production throughout different planting seasons.

Beyond its agronomic importance, shallot cultivation plays a strategic role in the regional economy. As one of the country's priority horticultural commodities, shallots contribute significantly to farmers' household income, generate employment opportunities across the agricultural value chain, and stimulate the growth of supporting industries, including seed production, agricultural input supply, transportation, processing, and marketing. Moreover, the commodity is essential for maintaining food security and stabilizing food prices because shallots

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are a staple ingredient in Indonesian cuisine and represent one of the commodities that substantially influence inflation.

The increasing demand for shallots, driven by population growth, urbanization, and expanding food industries, highlights the importance of enhancing production efficiency and improving cultivation practices. Consequently, sustainable shallot production has become a priority for both local and national governments in strengthening agricultural competitiveness, improving rural livelihoods, and supporting regional economic development. Development of Harvested Area and Shallot Production in North Sumatra Province, 2023–2024.

Table 1. Trends in Harvest Area and Onion Production in North Sumatra Province for the 2023–2024 Period.

Kabupaten/Kota	**Luas Lahan Bawang Merah (ha)**		**Produksi Bawang Merah (kwintal)**	
	2023	**2024**	**2023**	**2024**
01. Nias	-	-	-	-
02. Mandailing Natal	119,70	101,00	5.133,20	10.714,00
03. Tapanuli Selatan	166,75	187,87	5.459,32	4.854,53
04. Tapanuli Tengah	-	-	-	-
05. Tapanuli Utara	250,44	252,25	16.633,13	25.030,22
06. Toba	91,20	103,40	17.851,00	18.125,00
07. Labuhanbatu	-	-	-	-
08. Asahan	-	-	358,00	347,00
09. Simalungun	28,00	49,00	181.302,00	127.640,00
10. Dairi	300,00	351,00	54.025,00	43.361,00
11. Karo	883,00	1.090,00	218.373,80	198.596,00
12. Deli Serdang	15,00	13,50	5.115,00	4.202,00
13. Langkat	-	-	141,00	281,00
14. Nias Selatan	23,00	17,00	9,50	-
15. Humbang Hasundutan	**100,70**	**117,00**	**75.673,00**	**71.090,00**
16. Pakpak Bharat	11,70	7,16	1.916,06	766,32
17. Samosir	1,06	4,50	56.713,20	62.036,20
18. Serdang Bedagai	-	-	8.277,00	5.348,00
19. Batu Bara	-	-	439,00	1.583,10
20. Padang Lawas Utara	1,25	-	1.975,00	1.700,00
21. Padang Lawas	45,00	32,00	-	-
22. Labuhanbatu Selatan	-	-	-	-
23. Labuhanbatu Utara	-	-	-	-
24. Nias Utara	12,30	11,00	4,00	-
25. Nias Barat	-	-	-	-
26. Sibolga	-	-	-	-
27. Tanjung Balai	-	-	102,00	
28. Pematang Siantar	1,04	-	-	156,00
29. Tebing Tinggi	-	-	77,51.	337,19
30. Medan	-	-	39,10	68,50
31. Binjai	-	-	243,00	89,50
32. Padang Sidimpuan	44,00	60,00	5.994,00	4.374,00

33. Gunung Sitoli	-	-	-	0,30
Sumatera Utara	**2.094,14**	**2.396,68**	**655.851.82**	**580.499.86**

Source : Central Statistics Agency (BPS) of North Sumatra Province in Figures 2025

Based on Table 1.1, the harvested area of shallots in North Sumatra Province increased by 302.54 hectares in 2024, from 2,094.14 hectares in 2023 to 2,396.68 hectares in 2024. In contrast, shallot production in the province declined by 75,351.96 quintals, decreasing from 655,851.82 quintals in 2023 to 580,499.86 quintals in 2024. A similar phenomenon was observed in Humbang Hasundutan Regency, where the harvested area increased by 16.30 hectares, from 100.70 hectares in 2023 to 117.00 hectares in 2024. However, shallot production decreased by 4,583 quintals, from 75,673.00 quintals in 2023 to 71,090.00 quintals in 2024. This indicates that the expansion of harvested area was not accompanied by a corresponding increase in production, suggesting the presence of factors affecting productivity, such as adverse climatic conditions, pest and disease outbreaks, declining soil fertility, or suboptimal crop management practices.

Table 1 Trends in Harvest Area and Onion Production (Kwintal) in Humbang Hasundutan Regency for the 2023–2024 Period.

Kecamatan	**Luas Lahan Bawang Merah (ha)**		**Produksi Bawang Merah (Kwintal)**	
	2023	**2023**	**2023**	**2024**
1. Pakkat	-	-	**-**	**-**
2. Onan Ganjang	16	17	4.800	2.780
3. Sijamapolang	7	14	1.215	1.915
4. Dolok Sanggul	59	71	10.500	12.980
5. Lintong Nihuta	**71**	**75**	**12.860**	**12.480**
6. Paranginan	33	31	6.100	5.025
7. Baktiraja	104	105	24.080	20.690
8. Pollung	91	94	17.196	15.040
9. Parlilitan	6	3	922	180
10. Tarabintang	-	-	**-**	**-**
Humbang Hasundutan	**387**	**410**	**75.673**	**71.090**

Source: Central Statistics Agency (BPS) of Humbang Hasundutan Regency: In Figures 2025

Based on the harvested area and shallot production data in Humbang Hasundutan Regency, Lintong Nihuta District is one of the major shallot-producing areas, with the harvested area increasing from 71 ha in 2023 to 75 ha in 2024, while production declined from 12,860 quintals to 12,480 quintals. This trend indicates that the expansion of cultivated land has not been accompanied by improved productivity, suggesting challenges related to production efficiency and input utilization. As one of the leading shallot-producing districts in the regency, Lintong Nihuta provides a relevant setting for comparing the production cost efficiency of True Shallot Seed (TSS) and conventional bulb propagation, with the aim of identifying a more efficient and economically beneficial cultivation method for farmers.

Shallot farmers in Indonesia, particularly in North Sumatra, generally continue to rely on bulbs as their primary planting material. Although this propagation method has been practiced for generations, it is associated with several significant challenges, including high production costs and the risk of declining bulb quality due to seed-borne and bulb-transmitted diseases. Along with advances in agricultural technology, the use of True Shallot Seed (TSS) has been introduced as a more efficient and sustainable alternative for shallot propagation. Previous studies have demonstrated that the adoption of True Shallot Seed (TSS) can reduce production costs by up to 30% while enhancing plant resistance to soil-borne diseases, making it a promising innovation for improving the productivity, profitability, and sustainability of shallot farming system (Adiyoga et al., 2020).

Although True Shallot Seed (TSS) offers considerable potential for improving the efficiency and sustainability of shallot production, its adoption among farmers remains relatively low. Several factors contribute to the limited use of this technology, including restricted access to quality TSS and propagation technologies, limited technical knowledge regarding nursery management, and farmers' perceptions that TSS is less reliable than conventional bulb propagation. In addition, the lack of targeted extension services and technical assistance has slowed the dissemination of this innovation. Most farmers continue to rely on traditional cultivation practices that have been passed down through generations and are often reluctant to adopt new technologies that require substantial changes in crop management, cultivation techniques, and production practices. Consequently, despite the economic and agronomic advantages reported in previous studies, the diffusion of TSS technology has progressed at a relatively slow pace (Basuki, 2009)

The implementation of True Shallot Seed (TSS) technology in shallot cultivation also presents several technical and economic challenges that must be addressed to ensure its successful adoption. Compared with bulb propagation, TSS requires more complex nursery management, including seedling production, transplanting, and more intensive crop maintenance during the early stages of plant growth. Furthermore, environmental factors such as unfavorable climatic conditions, fluctuations in temperature and rainfall, and unsuitable soil conditions may reduce germination rates and limit the success of TSS-based cultivation. Farmers must also incur higher initial investment costs to establish appropriate nursery facilities, purchase high-quality seeds, and acquire the necessary cultivation inputs. These additional costs, combined with the uncertainty associated with a relatively unfamiliar production system, often discourage farmers from adopting TSS technology and encourage them to continue using conventional bulbs as their primary planting material. Therefore, increasing the adoption of True Shallot Seed (TSS) requires not only technological innovation but also comprehensive extension programs, farmer training, financial support, and institutional assistance to reduce production risks and strengthen farmers' confidence in the technology (Sayaka et al., 2020a)

To improve shallot productivity and production efficiency, various technological innovations have been introduced, including the use of True Shallot Seed (TSS) as an alternative to conventional bulb propagation. Previous studies have reported that TSS requires lower seed quantities, reduces seed costs, has a longer storage life, and offers greater yield potential than traditional bulb seeds. Nevertheless, the adoption rate of TSS among Indonesian farmers remains relatively low despite these documented advantages (Sayaka et al., 2020).

focused on the determinants of farmers' adoption of True Shallot Seed (TSS) technology. However, limited empirical evidence is available regarding the economic comparison between TSS and conventional bulb propagation, particularly in terms of production cost efficiency, farm revenue, and farm income under actual farming conditions. This study fills this research gap by providing a comprehensive comparative economic analysis of the two propagation methods in shallot farming (Roessali et al., 2019). Saidah et al. reported that the production of True Shallot Seed (TSS) in Central Sulawesi exhibited superior growth and yield performance under suitable agroecological conditions. Nevertheless, the study concentrated primarily on agronomic characteristics and seed productivity, with limited attention given to the economic aspects of shallot farming, such as production cost efficiency, farm revenue, and farm income (Saidah et al., 2020).

The novelty of this study lies in its comprehensive economic evaluation of shallot cultivation using True Shallot Seed (TSS) and conventional bulb propagation under actual farming conditions. Unlike previous studies, which primarily focused on agronomic performance, seed productivity, or farmers' adoption behavior, this study integrates production cost efficiency, farm revenue, and farm income into a single comparative framework. Furthermore, the research provides new empirical evidence from the highland agroecosystem of Humbang Hasundutan Regency, North Sumatra, where the economic performance of TSS has received limited scholarly attention. By combining comparative farm economic analysis with an assessment of the determinants of farmers' income using multiple linear regression, this study offers a more comprehensive understanding of the economic feasibility of TSS technology and supports evidence-based decision-making for sustainable shallot production.

Considering the increasing challenges in shallot cultivation, particularly those related to production costs and seed efficiency, this study entitled "Comparative Analysis of the Production Cost Efficiency of Shallots (*Allium ascalonicum* L.) Using Seed and Bulb Propagation in Lobutua Village, Lintong Nihuta District, Humbang Hasundutan Regency" is highly relevant in providing data-driven and comprehensive solutions. The findings of this study are expected to serve as a practical reference for farmers in selecting and adopting a more cost-efficient propagation method, while also contributing to improved farm profitability and enhancing the welfare of shallot farmers in Lobutua Village, Lintong Nihuta District, Humbang Hasundutan Regency.

METHODS

This study was conducted in Lobutua Village, Lintong Nihuta District, Humbang Hasundutan Regency, North Sumatra Province. The study area was selected using a purposive (judgmental) sampling approach, in which the research location was deliberately chosen based on specific characteristics relevant to the research objectives. Purposive site selection is appropriate when the researcher intentionally selects a location that possesses the most suitable attributes for addressing the research questions. Lobutua Village was chosen because it is one of the major shallot-producing areas in Humbang Hasundutan Regency and is characterized by a highland agroecological environment that is highly suitable for shallot cultivation. Furthermore, farmers in this area apply both True Shallot Seed (TSS) and conventional bulb propagation methods, providing an appropriate setting for comparing production cost efficiency, farm revenue, and farm income between the two cultivation systems. The study was carried out 2025.

This study employed a quantitative research approach using a comparative survey method. The quantitative approach was adopted because the study aims to measure and compare the production cost efficiency, farm revenue, and farm income of shallot farming using True Shallot Seed (TSS) and conventional bulb propagation based on numerical data collected from farmers. According to Creswell, (2014), quantitative research is an approach that examines relationships among variables through the collection and statistical analysis of numerical data, producing objective and generalizable findings. Furthermore, the survey method was selected because it enables researchers to obtain first-hand information from respondents regarding farming characteristics, production inputs, production costs, yields, and farm income under actual farming conditions. As stated by Sugiyono, (2018), survey research is conducted to collect data from a population or sample using research instruments in order to describe the actual characteristics of the object being studied. The comparative approach is particularly appropriate because this study compares two groups of farmers those using True Shallot Seed (TSS) and those using conventional bulb propagation to identify differences in production cost efficiency and economic performance between the two propagation methods.

The population of this study consisted of 267 shallot farmers in Lobutua Village, Lintong Nihuta District, Humbang Hasundutan Regency, who cultivated shallots using either True Shallot Seed (TSS) or conventional bulb propagation. Of the total population, 117 farmers used the TSS propagation method, while 150 farmers used bulb propagation. The sample was selected using the Simple Random Sampling (SRS) technique, whereby each farmer within the defined population had an equal and independent probability of being selected as a respondent. According to Sugiyono, (2017), Simple Random Sampling is a probability sampling method that ensures every member of the population has the same opportunity to be included in the sample, thereby minimizing selection bias and enhancing the representativeness of the sample. Similarly, Creswell, (2014) stated that probability sampling techniques, including Simple Random Sampling, are appropriate for quantitative research because they improve the generalizability of research findings to the target population.

The respondents were selected based on the following criteria:

1. Farmers who cultivated shallots using either True Shallot Seed (TSS) or conventional bulb propagation.
2. Farmers who were willing to participate in the study and provide the information required for the research.

$$n = \frac{n}{1 + n\,(Moe)^2}$$

Dimana :

n = Jumlah Sampel

N = Jumlah Populasi

Moe = Margin Of Error (20%)

$$n = \frac{267}{1 + 267\,(0.2)^2}$$

$$n = \frac{267}{11{,}68}$$

$$n = 22.85\ (23\ Sampel)$$

Data Analysis Methods

The collected data were analyzed using descriptive and quantitative statistical methods to address the research objectives. Descriptive statistics were employed to summarize farmers' characteristics, production inputs, production costs, and farming performance, whereas quantitative analyses were used to test the proposed hypotheses and compare the economic performance of shallot cultivation using True Shallot Seed (TSS) and conventional bulb propagation.

Production Cost Efficiency Analysis

The first hypothesis examined whether shallot cultivation using True Shallot Seed (TSS) is more cost-efficient than conventional bulb propagation.

Total Production Cost

Total production cost was calculated as:

$$TC = TFC + TVC$$

where

- TC = Total production cost (IDR)
- TFC = Total fixed cost (IDR)
- TVC = Total variable cost (IDR)

According toSoekartawi, (2006) , production cost consists of fixed costs and variable costs incurred during the farming process and represents the total economic sacrifice made to obtain agricultural output.

Production Cost Efficiency

Production cost efficiency was calculated as

$$Production\ Cost\ Efficiency = \frac{Total\ Production}{Total\ Production\ Cost} \times 100\%$$

where

Total Production = output (kg)
Total Production Cost = total production expenditure (IDR)

A lower production cost per unit of output indicates a more efficient production system. According to Soekartawi, (2006), economic efficiency reflects the ability of producers to obtain maximum output from a given combination of production inputs while minimizing production costs.

Independent Sample t-test

Differences in production cost efficiency between TSS and bulb propagation were analyzed using an Independent Samples t-test, since the study compares the mean values of two independent farmer groups.

The test statistic is

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

where

$\bar{X}_1, \bar{X}_2$= sample means
S_1^2, S_2^2= sample variances
n_1, n_2= sample sizes

According to Field (2018), the Independent Samples t-test is appropriate for determining whether two independent groups differ significantly in their mean values.

The hypothesis was accepted when $p < 0.05$, indicating a statistically significant difference between the two propagation methods.

Farm Income Analysis

The second hypothesis examined whether farmers using True Shallot Seed (TSS) obtain higher farm income than farmers using conventional bulb propagation.

Total Revenue

Farm revenue was calculated as

$$TR = Y \times P_y$$

where

TR = Total revenue (IDR)
Y = Production quantity (kg)
Py = Selling price (IDR/kg)

Farm Income

Farm income was calculated as

$$\pi = TR - TC$$

where

π = Farm income (IDR)

TR = Total revenue

TC = Total production cost

According to Soekartawi, (2006) , farm income is the difference between total revenue obtained from agricultural production and total production costs incurred during the farming process.

The resulting income was then compared with the Humbang Hasundutan Regency Minimum Wage (UMK) for 2024, amounting to IDR 2,809,915, to evaluate farmers' income levels.

Multiple Linear Regression Analysis

The third hypothesis examined whether production factors significantly influence the production cost of shallot farming under both propagation methods.

The regression model is expressed as

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + \varepsilon$$

where

Y = Production cost

X_1 = Capital

X_2 = Land area

X_3 = Seed cost

X_4 = Fertilizer cost

X_5 = Pesticide cost

X_6 = Labor cost

X_7 = Equipment depreciation

β_0 = Intercept

$\beta_1 ... \beta_7$ = Regression coefficients

ε = Error term

According to Gujarati & Porter, (2009), multiple linear regression is an appropriate analytical tool for examining the simultaneous influence of several independent variables on a single dependent variable while controlling for the effects of other variables.

Partial Significance Test (t-test)

The significance of each explanatory variable was evaluated using the t-test at the 5% significance level.

According to Sugiyono, (2018), the t-test determines whether an individual regression coefficient differs significantly from zero while holding other explanatory variables constant.

A variable was considered statistically significant when $p < 0.05$.

Simultaneous Significance Test (F-test)

The joint significance of all explanatory variables was evaluated using the F-test.

According to Gujarati & Porter, (2009), the F-test assesses whether all independent variables collectively explain variation in the dependent variable.

The regression model was considered significant when

$$p < 0.05$$

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Coefficient of Determination (R^2)

The explanatory power of the regression model was evaluated using the coefficient of determination (R^2).

According to Gujarati & Porter, (2009), R^2 measures the proportion of variation in the dependent variable explained by the independent variables included in the regression model. Higher R^2 values indicate greater explanatory power.

RESULTS AND DISCUSSION

Result

1. Production Costs for Red Onion Farming Using the Seed Propagation Method (TSS)

Table 3 below presents the average production costs for red onion farming using the seed propagation method (TSS) based on research findings.

Table 2 Average Production Costs for Onion Farming Using the Seed Method (TSS)

Komponen Biaya	Nilai (Rp) Per Petani	Nilai (Rp) Per Hektar	Persentase (%)
Total Fixed Cost (TFC)	505.300	8.018.332	8,7
Total Variable Cost (TVC)	4.863.500	84.220.597	91,3
Total Cost (TC)	5.368.800	92.238.929	100,00

Based on Table 3, variable costs (TVC) accounted for the largest proportion of the total production cost under the True Shallot Seed (TSS) propagation method, representing 91.3% of the total production cost, while fixed costs (TFC) contributed only 8.7%. This finding indicates that shallot farming using the TSS method is highly dependent on variable production inputs, particularly seeds, fertilizers, pesticides, and labor. The dominance of variable costs suggests that improvements in the efficiency of input use are critical for reducing production costs and enhancing farm profitability. This finding is consistent with the study by (Ismiasih & Afroda, 2023), which reported that labor, seeds, fertilizers, and other production inputs are the primary determinants of technical efficiency in shallot farming in Indonesia. Their study emphasizes that optimizing variable input allocation is essential to improve production efficiency and farmers' economic performance

2. Production Costs for Red Onion Farming Using the Bulb Propagation Method

Table 4 below presents the average production costs for red onion farming using the bulb propagation method.

Table 3 Average Production Costs for Onion Farming Using the Bulb Method

Komponen Biaya	Nilai (Rp) Per Petani	Nilai (Rp) Per Hektar	Persentase (%)
Total Fixed Cost (TFC)	360.308	5.386.743	5,8
Total Variable Cost (TVC)	8.760.154	87.409.331	94,2
Total Cost (TC)	9.120.462	92.796.073	100,00

Source : Production Cost Structure of Bulb Propagation

Based on Table 4, the average production cost structure of shallot farming using the conventional bulb propagation method exhibited a pattern similar to that of the True Shallot Seed (TSS) method, with variable costs representing the dominant component of total production costs. Variable costs accounted for 94.2% of the total production cost, whereas fixed costs contributed only 5.8%. Although the total production cost under the bulb propagation method was comparable to that of the TSS method, the cost composition differed. Specifically, the bulb propagation method incurred a lower proportion of fixed costs but a higher proportion of variable costs than the TSS method. This finding indicates that bulb-based shallot cultivation relies more heavily on recurring expenditures for production inputs such as planting materials, fertilizers, pesticides, and labor. Similar findings were reported byLailandra et al., (2024) , who demonstrated that the efficiency and profitability of shallot farming are strongly influenced by the management of variable production inputs, as these constitute the largest share of total production costs. Therefore, fluctuations in input prices are likely to have a greater impact on the economic performance of bulb-based farming systems than on production systems with lower variable cost intensity.

Comparison of Production Costs between True Shallot Seed (TSS) and Bulb Propagation

The comparison of the two production systems indicates that the average total production cost of shallot farming using the True Shallot Seed (TSS) method was slightly lower than that of conventional bulb propagation, amounting to IDR 92,238,929 and IDR 92,796,073 per hectare, respectively. Although the difference in total production cost was relatively small, the cost structures varied between the two propagation methods. Under the TSS method, variable costs accounted for 91.3% of total production costs, while fixed costs represented 8.7%. In contrast, bulb propagation exhibited a higher proportion of variable costs (94.2%) and a lower proportion of fixed costs (5.8%). These results suggest that the TSS method involves relatively higher fixed costs, primarily associated with equipment depreciation and long-term production assets, whereas bulb propagation is more dependent on variable inputs such as planting materials, fertilizers, pesticides, and labor. Consequently, the bulb propagation system is more vulnerable to fluctuations in input prices, while the TSS method has greater potential to improve production cost efficiency through reduced dependence on variable inputs.

These findings are consistent with the economic theory of farm management proposed bySoekartawi, (2013), which states that production systems with a lower proportion of variable costs tend to be more economically efficient because farmers have greater control over production expenditures. Furthermore, recent studies by Ismiasih & Jamhari, (2024) similarly concluded that variable inputs including seeds, fertilizers, pesticides, and labor constitute the largest share of production costs in shallot farming. Therefore, improving the efficiency of variable input utilization is a key strategy for reducing production costs, increasing profitability, and enhancing the economic sustainability of shallot farming.

Calculation of Cost Efficiency

Production cost efficiency is calculated by comparing the production volume to the total production costs incurred, then multiplying the result by 100 percent. This calculation aims to determine the extent to which the costs incurred can be converted into production output in kilograms of shallots.

Table 4 Production Cost Efficiency of Onion Farming Using the Seed Method (TSS) in Lobutua Village in 2025

Komponen	**Nilai Per Petani**	**Nilai Per Hektar**
Produksi Rata-rata (Kg)	505,4	8.635
Biaya Produksi Rata-rata (Rp)	5.368.800	92.238.929
Efisiensi (%)	**0,0094%**	**0,0094%**

Based on Table 5, the True Shallot Seed (TSS) propagation method produced an average yield of 505.4 kg per farmer with an average total production cost of IDR 5,368,800. The calculated production cost efficiency was 0.0094 kg per IDR spent equivalent to 0.94 kg per IDR 100 of production cost. This indicates that every IDR 100 invested in production generated approximately 0.94 kg of shallot output, suggesting that the TSS propagation method utilized production costs more efficiently than the conventional bulb propagation method.

The relatively higher production cost efficiency observed under the TSS method indicates a favorable level of production performance. This may be attributed to several factors, including the use of genetically uniform seeds, better crop establishment, improved adaptability of TSS plants to local environmental conditions, and more effective crop management practices. These findings are consistent with recent studies showing that the use of True Shallot Seed (TSS) can improve input-use efficiency and increase productivity by reducing dependence on bulky planting materials while promoting more uniform plant growth and better resource utilization (Ismiasih & Jamhari, 2024; Saidah et al., 2020). Consequently, TSS technology has considerable potential to enhance the economic efficiency and sustainability of shallot farming systems.

Table 5 Production Cost Efficiency of Onion Farming Using the Bulb Method in Lobutua Village in 2025

Komponen	**Nilai Per Petani**	**Nilai Per Hektar**
Produksi Rata-rata (Kg)	748,2	7.615
Biaya Produksi Rata-rata (Rp)	9.120.462	92.796.073
Efisiensi (%)	**0,0082%**	**0,0082%**

The results presented in Table 6 indicate that shallot farming using the conventional bulb propagation method produced an average yield of 748.2 kg per farmer with an average total production cost of IDR 9,120,462. The calculated production cost efficiency was 0.0082 kg per IDR 100 of production cost equivalent to 0.000082 kg per IDR. In other words, every IDR 100 invested in production generated approximately 0.0082 kg of shallot output.

The lower efficiency value suggests that production expenditures under the bulb propagation method were utilized less efficiently than those under the True Shallot Seed (TSS) method. Several factors may explain this result. First, bulb planting materials require substantially higher procurement costs than TSS, thereby increasing the proportion of variable production costs without a proportional increase in output. Second, the use of bulbs as planting material often results in greater variability in plant establishment and growth, leading to less uniform crop development and consequently lower production efficiency. Third, bulb propagation is generally more susceptible to pests and diseases, particularly bulb rot and soil-borne pathogens, which increase crop protection costs while not always translating into higher productivity.

These findings also support the concept of economic efficiency proposed byFarrel, (1957) Farrell (1957), which states that a production system is considered more efficient when it is capable of generating greater output from a given set of production inputs through the optimal allocation of available resources. Therefore, the superior production cost efficiency achieved by the TSS method in this study can be attributed not only to lower planting material costs but also to better crop uniformity, healthier seedlings, and more efficient utilization of production inputs throughout the cultivation process.

Comparison of Production Cost Efficiency between True Shallot Seed (TSS) and Bulb Propagation

A comparison of the two propagation methods revealed that the TSS method achieved a production cost efficiency of 0.0094 kg per IDR 100 of production cost, whereas the bulb propagation method recorded only 0.0082 kg per IDR 100. Although the numerical difference appears relatively small (0.0012 kg per IDR 100), it becomes economically meaningful when applied to commercial-scale shallot farming. A higher production cost efficiency indicates that farmers are able to generate greater output from the same level of production expenditure, thereby improving farm profitability and resource-use efficiency. Consequently, the TSS method demonstrated superior economic performance in terms of converting production costs into agricultural output.

The higher efficiency of the TSS method can be attributed to several technical and economic advantages. Compared with conventional bulb propagation, TSS requires lower expenditure on planting materials, produces more uniform crop establishment, and generally exhibits better adaptability to environmental conditions. In contrast, bulb propagation involves higher seed costs, greater variability in plant growth, and increased vulnerability to pest and disease infestations, particularly bulb rot, which raises production costs without proportionally increasing yield.

The lower production cost efficiency of the bulb propagation method indicates that production costs in this system are not as efficient as those of the True Shallot Seed (TSS) method. One of the main causes is the high cost of procuring bulb seeds, which is the largest component of variable costs in shallot farming. Compared to TSS seeds, bulb seeds require a much larger volume of seed per unit area, thereby increasing production costs from the start of the growing season. Compared to TSS seeds, tuber seeds require a much larger seed volume per unit area, thereby increasing production costs from the start of the growing season. In addition, TSS seeds offer the advantages of requiring fewer seeds, lower transportation and storage costs, and higher yield potential compared to tuber seeds. These factors make TSS a more economical source of planting material in the long term (Sayaka et al., 2020b)

Independent Samples t-Test

An independent samples t-test was conducted to determine whether there was a significant difference in the production cost efficiency of shallot farming between the seed propagation method (TSS) and the bulb propagation method.

Table 6 Group Statistics T-Test

	Metode	N	Mean	Std. Deviation	Std. Error Mean
BiayaProduksi	Biji	10	7868800.00	1576730.235	498605.880
	umbi	13	14582000.00	4143102.647	1149089.926

Table 7 shows that the average production cost of shallot farming using the True Shallot Seed (TSS) method was IDR 7,868,800 per growing season, whereas the average production cost under the conventional bulb propagation method reached IDR 14,582,000. This indicates that the average production cost of bulb propagation was approximately 85.3% higher than that of the TSS method. Furthermore, the bulb propagation system exhibited a substantially higher standard deviation (IDR 4,143,103) than the TSS method (IDR 1,576,730), indicating greater variability in production costs among farmers. In contrast, production costs under the TSS system were relatively more consistent, suggesting a more standardized pattern of input utilization.

The observed difference in average production costs can be explained by differences in input requirements between the two propagation methods. Under the conventional bulb system, planting material constitutes the largest component of variable production costs because farmers generally require approximately 1.0–1.5 tons of seed bulbs per hectare. In comparison, the TSS system requires only a few kilograms of botanical seed per hectare, substantially reducing seed procurement costs. In addition, TSS offers lower transportation and storage costs, easier seed handling, and reduced post-harvest losses during storage, all of which contribute to lower overall production expenditures.

Askari-Khorasgani & Pessarakli, (2019)reported that TSS cultivation requires only

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approximately 1.5–5 kg ha^{-1} of botanical seed, whereas conventional bulb propagation requires approximately 1.2–2.0 t ha^{-1} of seed bulbs. This substantial difference in planting material requirements explains why seed procurement represents one of the largest production cost components in bulb-based cultivation systems. The larger volume of planting material also increases transportation, storage, and handling expenses before planting. Therefore, the significantly lower average production cost observed in the TSS system in this study is a logical consequence of its greater planting-material efficiency.

Table 7 Independent Samples Test Hasil T-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
BiayaProduksi	Equal variances assumed	9.576	.005	-4.840	21	.000	-6713200.000	1387046.414	-9597720.925	-3828679.075
	Equal variances not assumed			-5.359	16.179	.000	-6713200.000	1252603.481	-9366209.777	-4060190.223

Levene's test for equality of variances produced an F-value of 9.576 with a significance level of 0.005, indicating that the assumption of equal variances was violated. Therefore, the comparison of mean production costs was based on the Welch's t-test (Equal variances not assumed), which is more appropriate when group variances are unequal. The test results revealed a t-value of -5.359 with 16.179 degrees of freedom and a two-tailed significance value of 0.000, indicating a statistically significant difference in production costs between the True Shallot Seed (TSS) and conventional bulb propagation methods at the 95% confidence level. Consequently, the null hypothesis was rejected, confirming that the two cultivation methods differ significantly in terms of production costs.

The average production cost under the TSS system was IDR 7,868,800, whereas the conventional bulb propagation system required IDR 14,582,000, resulting in a mean difference of IDR 6,713,200. The negative mean difference indicates that production costs under the TSS system were significantly lower than those under bulb propagation. Moreover, the 95% confidence interval ranged from −IDR 9,366,210 to −IDR 4,060,190, entirely below zero, providing strong statistical evidence that the observed difference was not due to sampling variability.

CONCLUSION

The independent samples t-test indicates a significant difference in production costs between shallot farming using the True Shallot Seed (TSS) method and conventional bulb propagation. The TSS method demonstrates lower production costs, indicating that it is a more cost-efficient production system than conventional bulb propagation. These findings suggest that TSS technology offers greater economic efficiency through more efficient input utilization, particularly in planting materials, thereby enhancing the competitiveness and sustainability of shallot farming.

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